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Comparison of Casein Phosphopeptide-Amorphous Calcium Phosphate and High-Fluoride Dentifrices in reducing White spot Lesions during Orthodontic Treatment

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ABSTRACT

Objective: To compare the effectiveness of CPP-ACP paste and high-fluoride toothpaste (1400ppm) on the demineralized enamel surfaces that appear to develop white-spot lesions in patients seeking fixed orthodontic treatment.

Methodology: This randomized control trial was conducted at the OPD of Orthodontic Department, Institute of Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro from January 2020 - July 2020. After evaluating scores of lesions, participants are provided with their respective preventive measures according to their division in the randomized control trial. Group one is provided with high fluoridated toothpaste at 1400 ppm that is commercially available in markets under the name Colgate Total twice daily for a period of 56 days. The other group is asked to visit OPD for the application of a paste of CPP-ACP once a week for a period of 56 days. Both groups are supposed to make three follow-ups at days 15, 34, and 56.

Results: This study consists of 126 participants. Out of 126 participants, 48.0% were males and 57.94% were female. The mean age of the cases was 17.8 years. Out of total, 48% were males and 57.94% were females, with a mean age of 15.99±2.183. A comparison of high fluoridated toothpaste and CPP-ACP paste after three consecutive follow-ups shows that both of them are effective in reducing white spot lesions, but high-fluoridated toothpaste is observed to be more effective during this trial.

Conclusion: High-fluoridated toothpaste and CPP-ACP paste, observed to be effective after three consecutive follow-ups in reducing white spot lesions, while high-fluoridated toothpaste was observed to be more effective during the trial.

Key words: WPL, efficacy, CPP-ACP, high-fluoride toothpaste.

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Introduction

Clinically, white-spot lesions (WSLs) are defined as opaque, white lesion areas initiated by mineral loss below the outer-most enamel layer, which is considered as the most common sequel of fixed orthodontic treatment.[1] White spot lesions are basically slightly softer surfaces in comparison with sound enamel with a lower amount of mineral content in it. The most frequently detected consequence of fixed orthodontics is the development of early carious lesions surrounded by brackets and bands.[2]

Fixed appliances on the labial surfaces of teeth make it difficult for the patients to keep the teeth clean, which leads to the formation of plaque and WSLs.[3] Incapability of brushing increases the number of sites conducive to

plaque retention. Poor oral hygiene lowers the pH of plaque surrounded by brackets, which prevents remineralization and can lead to demineralization of enamel[4]. Bacteria's present in dental plaque are considered the main culprits in the formation of early carious lesions, which lead to the development of white spot lesions.

Microbiological alterations in the oral flora can arise during orthodontic treatment. Therefore, it is necessary to evaluate the patient's oral hygiene status before commencing orthodontic treatment.[4] According to a study, the patients who are receiving orthodontic treatment with fixed appliances possess a more intricate biofilm that contains a greater degree of bacterial resistance.[5] Bacteria generate organic acids that infiltrate the interprismatic gaps in tooth enamel, leading to the formation of white lesions as a result of apatite crystal dissolution, calcium and phosphate ion release, and demineralization. [6,7] The prevalence of white spot lesions following orthodontic treatment varies from 2% to 96%.[8] The most recently done report on the development and occurrence of white-spot lesions showed that 72.9% of patients seeking fixed orthodontic treatment are prone to developing one or more new lesions on tooth surfaces during treatment.[9]

Remineralization is defined as a process of redeposition of mineral contents into the enamel surface, such as, calcium, phosphate, and fluoride ions.[10] this process promotes ion deposition into voids of demineralized enamel. Remineralization can be done by a natural process, such as the witch-hazel of saliva. Saliva plays a major role due to the presence of calcium salts, phosphate, and fluoride ions required for remineralization and maintaining the integrity of the enamel surface. Casein phosphuretted-amorphous calcium phosphate (CPP-ACP) is a paste prescribed for the remineralization of WSLs. This contains an active mediator, casein phosphopeptide amorphous calcium phosphate, which is considered to stabilize and limit calcium salts, fluoride ions, and phosphates at the tooth's surface in a slow releasing amorphous form, causing remineralization of WSLs. When the mouth's pH is acidic, plaque remains accumulated for a long time, which ultimately leads to tooth decay. Saliva is considered the body's normal oral protective system. It protects teeth and soft tissues, cleanses bacteria and food away from the teeth, and decreases enamel demineralization. Its buffering capability helps neutralize acids to preserve pH levels and can refills the calcium, phosphate, and fluoride that are necessary for demineralizing teeth's enamel. It has been declared that it maintains enamel mineral content by initiating remineralization of carious lesions. It has been observed that it reduces the pH of micro-organisms and prevents enamel integrity by acting as a buffering agent.[11]

Basically, CPP-ACP is a milk-derived protein, that is capable of releasing calcium and phosphate and is also thought to be effective in dentine hypersensitivity, acid erosions, and in patients with a high incidence of dental caries.[12] It is essential to use effective methods to prevent these lesions during orthodontic treatment and to administer suitable therapies after treatment to achieve desirable outcomes and ensure patient satisfaction. [7] Some products that are available commercially, such as Tooth Mousse Plus and MI Paste Plus, show this same synergistic effect as these materials not only contain CPP- ACP but also contain 900 ppm fluoride. Overall management of clinically apparent white-spot lesions is to prevent demineralization as well as to promote remineralization potential of the tooth surface. Scientific evidence for the proper use of fluorides to avoid enamel demineralization is well established. Fluorides conveyed through mouth washes, varnishes, mouth gels, and fluoride-releasing cements are registered for reduction of the degree and incidence of White-spot lesions during fixed orthodontic treatment. The International Caries Detection and Assessment System (ICDAS) offers a pattern for the assessment of dental cavities. This system was formed just to present an improved understanding of the process of initiation and progression of dental caries, which can be easily applied by dentists in general clinical practice.

ICDAS frequently uses the clinical examination of the facial surfaces of the anterior and premolars to detect WSLs and scores them "1" and "2," pointing 'early-stage decay'. [13] The basic purpose of this study is to compare the effectiveness of CPP-ACP paste with high-fluoridated toothpaste (1400 ppm) on the demineralized enamel surfaces that appear to develop white-spot lesions in patients seeking fixed orthodontics.

Methodology

This comparative randomized control trial study was conducted at the OPD of the Orthodontic Department, Institute of Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro from Jan 2020-July 2020. All the cases having more than 2 WSLs on more than 2 teeth, aged 13–27 years, and of either gender were included. All the study participants were divided into two groups. Informed written consent is taken by each and every patient before giving them preventive measures. An intraoral examination will be carried out on each patient

having orthodontic treatment for a minimum of 1 month. Teeth are cleaned properly before examination by using cotton swabs, and then visual examinations are carried out in standard lighting conditions on the dental unit. The labial surfaces of the maxillary right canine and left canine are examined. Teeth are isolated with cotton and air-dried for 5 seconds before examination. Below the cervical margins of the teeth surfaces above arch wires, are examine for the presence of white-spot lesions, as these are areas most susceptible to demineralization during fixed orthodontic treatment. Lesions were scored according to the visual examination criteria (VEC), which codes from 0 to 2.

WSLs are also scored using the International Caries Detection and Assessment System (ICDAS). That score was 0-6. After evaluating scores of lesions, participants are provided with their respective preventive measures according to their division in the randomized control trial. Group one is provided with high-fluoridated toothpaste at 1400 ppm twice daily for a period of 56 days. The other group is asked to visit OPD for the application of a paste of CPP-ACP once a week for a period of 56 days. Both groups are required to conduct three follow-ups on days 15, 34, and 56. All the information was collected via a study proforma, and the data was analyzed by SPSS version 26.

Results

This study consists of 126 participants. Out of 126 participants, 48.0% were males and 57.94% were female. The mean age of the cases was 17.8 years. Table.1 his study consists of 126 participants. Out of 126 participants, 48.0% were males and 57.94% were female. The mean age of the cases was 17.8 years. Table I

Table I: Descriptive statistics of demographic characteristics (n=126)

Variables		Statistics
Age (mean±SD)		17.48±3.32 years
Gender	Males	42.06%
	Females	57.94%
Occupation	Students	85.7%
	House lady	14.3%

The comparative means of the mode of treatment given to the total number of patients based on the ICDAS at Day 15 were recorded as 4.65±0.481 for patients with the therapy of high fluoridated toothpastes and 4.19±0.390 for patients given the therapy of CPP-ACP paste. At Day 34, were recorded as 2.98±0.06 for patients with the therapy of high fluoridated toothpastes and 3.06±0.40 for patients given the therapy of CPP-ACP paste. At Day 56, were recorded as 1.16±0.40 for patients with therapy of high fluoridated toothpastes and 2.23±0.75 for patients given the therapy of CPP-ACP paste, as shown in Table II.

The comparative means of mode of treatment given to the total number of patients based on VEC at Day 15 were recorded as 1.24±0.46 to patients with therapy of high fluoridated toothpastes and 1.75±0.43 with patients given the therapy of CPP-ACP paste. At Day 34, were recorded as 2.57±0.49 for patients with the therapy of high fluoridated toothpastes and 2.44±0.50 for patients given the therapy of CPP-ACP paste. At Day 56, were recorded as 1.14±0.35 to patients with therapy of high fluoridated toothpastes and 2.08±0.54 for patients given the therapy of CPP-ACP paste, as shown in Table III.

Table II; Comparative means of mode Of Treatment with ICDAS On day 15, 34 and 56, (n=126)

Mode of treatment		Mean	SD	SEM	p-value
Days 15 with ICDAS	High-fluoride toothpaste	4.65	0.481	0.061	0.001
	CPP-ACP paste	4.19	0.390	0.050	
Days 34 with ICDAS	High-fluoride toothpaste	2.98	0.604	0.076	0.095
	CPP-ACP paste	3.06	0.400	0.051	
Days 56 with ICDAS	High-fluoride toothpaste	1.16	0.407	0.051	0.001
	CPP-ACP paste	2.23	0.756	0.096	

SEM= Standard error mean

Table III: Comparative means of mode of treatment with VEC on day 15, 34 and 56, (n=126)

Mode of treatment		Mean	SD	SEM	p-value
Days 15 with VEC	High-fluoride toothpaste	1.24	0.465	0.059	0.001
	CPP-ACP paste	1.75	0.439	0.055	
Days 34 with VEC	High-fluoride toothpaste	2.57	0.499	0.063	0.001
	CPP-ACP paste	2.44	0.501	0.063	
Days 56 with VEC	High-fluoride toothpaste	1.14	0.353	0.044	0.088
	CPP-ACP paste	2.08	0.548	0.069	

Discussion

Orthodontic treatment, while essential for aligning teeth and improving oral health, can also cause the development of white spot lesions (WSLs) on the enamel surface due to plaque accumulation and demineralization. Casein

Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) and High-Fluoride Dentifrices (HFD) have been used as interventions to prevent and reduce the severity of WSLs during orthodontic treatment. This article aims to compare the effectiveness of CPP-ACP and HFD in reducing WSLs during orthodontic treatment. In this study, each patient of both groups was called to make their 3 possible follow- ups on day 15, day 34 and 56 for proper evaluation of remineralized enamel surfaces of White-spot lesions after application of any topical application according to two different scoring systems, ICDAS and VEC. High fluoridated toothpastes at 1400 ppm are showed some more effectiveness and it is also commonly available in markets under different brand names. Patients have been used easily twice or thrice a day with fixed orthodontic treatment. This high amount of fluoride applied twice a day prevents further demineralization of White-spot lesions and promotes remineralization of these lesions. Different studies described that, fluorides in high-concentration are considerably effective in decreasing white-spot lesions.

Khoroushi M et al[14] reported that the to manage WSLs, the initial step involves developing good oral hygiene habits and preventive measures with the use of topical fluorides such as fluoride toothpaste, mouthwash, and gel. Remineralization therapy, which may involve the application of high-concentration fluoride products, calcium and phosphate-containing agents, or resin infiltration, is also recommended. It is worth noting that elastic ligatures and fluoride-containing bonding materials are typically used in orthodontic treatment and are not directly associated with WSL management.[15] In the study by Du M et al[15] observed that the use of topical fluoride varnish is a successful method in reversing WSLs after debonding and should be promoted as a standard preventative measure against cavities after orthodontic treatment.

On the other hand, Imani MM et al[16] reported that the CPP-ACP can reduce the occurrence and enhance the remineralization of WSLs while undergoing or after orthodontic treatment, but they did not compare it with High fluoridated toothpastes. In a narrative review by Lazar L et al[17] stated that the regular use of toothpaste containing over 1000 ppm fluoride at home can lower the incidence of WSL separation, while consistent application of varnishes during office visits can only reduce the prevalence of WSLs when coupled with a strict oral hygiene regimen. Few studies verified that high-fluoridated products derivate suggestively reduced white-spot lesions after every sixth week to six months, though their adversary remain unsuccessful to establishing the supplementary effects of fluoride varnish during eight-week period when compared with home care therapies.

Assessing the results of this current study, we can state that the proper usage of high fluoridated toothpaste at 1400 ppm and CPP-ACP paste during and after fixed orthodontic treatment is suggestively effective in the reduction of demineralized white spots, however, the use of CPP-ACP paste has been proved to be more effective than fluoridated tooth pastes in remineralization of early carious lesions of demineralized tooth surfaces. This is also important to consider if there are interpreters for the improvements in white-spot lesions - such as from the removal of the fixed brace, or the severity of the lesions on tooth surfaces.

Conclusion

High-fluoridated toothpaste and CPP-ACP paste, observed to be effective after three consecutive follow-ups in reducing white spot lesions, while high-fluoridated toothpaste was observed to be more effective during the trial. White-spot lesions remain a topic of concern as they are a very common complication of fixed orthodontic treatment and have beneficial visual associations with anterior teeth. The extensive works available concerning these areas are divided into diagnosis, anticipation, and treatment of white-spot lesions. This study focuses on the diagnosis of white-spot lesions and its treatment efforts to improve our knowledge so that substantial benefit in treating fixed orthodontic patients may be gained.

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